PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 27 June 2001 (27.06.01)	
International application No. PCT/GB00/03964	**Applicant's or agent's file reference** 4/W32367WO
International filing date (day/month/year) 16 October 2000 (16.10.00)	**Priority date** (day/month/year) 19 October 1999 (19.10.99)
Applicant DING, Li et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

02 May 2001 (02.05.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Juan Cruz
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

ASK

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
4/W32367WO		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 00/ 03964	16/10/2000	19/10/1999
Applicant		
SHIMADZU RESEARCH LABORATORY (EUROPE) LTD. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 3a

   [X] as suggested by the applicant.

   [ ] None of the figures.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted] 00/03964

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01J49/42 H01J49/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 206 506 A (KIRCHNER NICHOLAS J) 27 April 1993 (1993-04-27) abstract column 29; figures 1,20	1,16
P,X	SHERETOV E P ET AL: "Opportunities for optimization of the rf signal applied to electrodes of quadrupole mass spectrometers. part ii. EC signals" INTERNATIONAL JOURNAL OF MASS SPECTROMETRY, ELSEVIER SCIENCE PUBLISHERS, AMSTERDAM, NL, vol. 198, no. 1-2, April 2000 (2000-04), pages 97-111, XP004193741 ISSN: 1387-3806 page 104 -page 106; figure 6	1,16

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 September 2001	19/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Hulne, S

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted] 00/03964

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	SCHLUNEGGER U P ET AL: "FREQUENCY SCAN FOR THE ANALYSIS OF HIGH MASS IONS GENERATED BY MATRIX-ASSISTED LASER DESORPTION/IONIZATION IN A PAUL TRAP" RAPID COMMUNICATIONS IN MASS SPECTROMETRY, LONDON, GB, vol. 13, 1999, pages 1792-1796, XP000972551 cited in the application the whole document ---	1,16
A	SHERETOV: "Theory of the pulsed quadrupole mass spectrometer." SOVIET PHYSICS TECHNICAL PHYSICS., vol. 17 , no. 5, 1972, pages 755-760, XP000972552 AMERICAN INSTITUTE OF PHYSICS. NEW YORK., US cited in the application the whole document -----	1,16

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PC[redacted] 00/03964

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5206506 A	27-04-1993	AU 643653 B2	18-11-1993
		AU 1469392 A	07-09-1992
		CA 2079910 A1	13-08-1992
		DE 69210496 D1	13-06-1996
		DE 69210496 T2	09-01-1997
		EP 0524311 A1	27-01-1993
		JP 2865865 B2	08-03-1999
		JP 5509437 T	22-12-1993
		WO 9214259 A1	20-08-1992

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 April 2001 (26.04.2001)

PCT

(10) International Publication Number
WO 01/29875 A3

(51) International Patent Classification[7]: H01J 49/42, 49/02

(21) International Application Number: PCT/GB00/03964

(22) International Filing Date: 16 October 2000 (16.10.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
9924722.3 19 October 1999 (19.10.1999) GB

(71) Applicant *(for all designated States except US)*: **SHIMADZU RESEARCH LABORATORY (EUROPE) LTD.** [GB/GB]; Wharfside, Trafford Wharf Road, Manchester M17 1GP (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **DING, Li** [CN/GB]; 1 Wenlock Road, Sale, Manchester M33 3TR (GB). **NUTTALL, James, Edward** [GB/GB]; 3 Reeds Close, Rawtenstall, Rossendale, Lancashire BB4 8ND (GB).

(74) Agent: **MATHISEN, MACARA & CO.**; The Coach House, 6-8 Swakeleys Road, Ickenham, Uxbridge, Middlesex UB10 8BZ (GB).

(81) Designated States *(national)*: JP, RU, US.

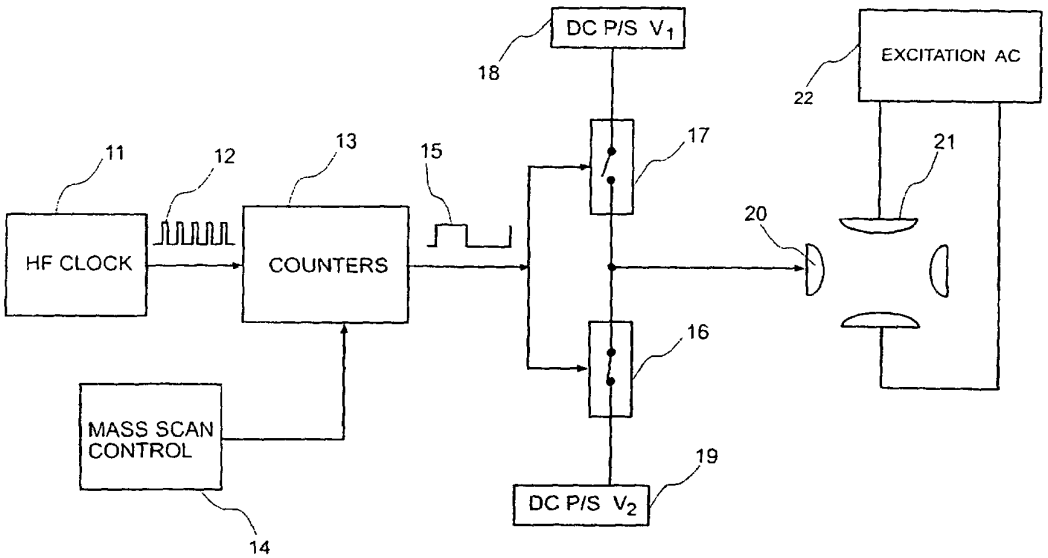
(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published:
— *with international search report*

(88) Date of publication of the international search report:
2 May 2002

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHODS AND APPARATUS FOR DRIVING A QUADRUPOLE ION TRAP DEVICE



(57) Abstract: A digital drive apparatus (Fig. 3) for quadrupole device such as a quadrupole ion trap has a digital signal generator (11, 13, 14; 24, 25, 26) and a switching arrangement (16, 17) which alternately switches between high and low voltage levels (V_1, V_2) to generate a rectangular wave drive voltage. A dipole excitation voltage is also supplied to the quadrupole device to excite resonant oscillatory motion of ions.

WO 01/29875 A3

INTERNATIONAL SEARCH REPORT

Inter[redacted]pplication No
PCT/GB 00/03964

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01J49/42 H01J49/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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P,X	SHERETOV E P ET AL: "Opportunities for optimization of the rf signal applied to electrodes of quadrupole mass spectrometers. part ii. EC signals" INTERNATIONAL JOURNAL OF MASS SPECTROMETRY, ELSEVIER SCIENCE PUBLISHERS, AMSTERDAM, NL, vol. 198, no. 1-2, April 2000 (2000-04), pages 97-111, XP004193741 ISSN: 1387-3806 page 104 -page 106; figure 6	1,16

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 September 2001	19/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Hulne, S

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	SCHLUNEGGER U P ET AL: "FREQUENCY SCAN FOR THE ANALYSIS OF HIGH MASS IONS GENERATED BY MATRIX-ASSISTED LASER DESORPTION/IONIZATION IN A PAUL TRAP" RAPID COMMUNICATIONS IN MASS SPECTROMETRY, LONDON, GB, vol. 13, 1999, pages 1792-1796, XP000972551 cited in the application the whole document	1,16
A	SHERETOV: "Theory of the pulsed quadrupole mass spectrometer." SOVIET PHYSICS TECHNICAL PHYSICS., vol. 17 , no. 5, 1972, pages 755-760, XP000972552 AMERICAN INSTITUTE OF PHYSICS. NEW YORK., US cited in the application the whole document	1,16

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte. Application No
PCT/GB 00/03964

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5206506 A	27-04-1993	AU 643653 B2	18-11-1993
		AU 1469392 A	07-09-1992
		CA 2079910 A1	13-08-1992
		DE 69210496 D1	13-06-1996
		DE 69210496 T2	09-01-1997
		EP 0524311 A1	27-01-1993
		JP 2865865 B2	08-03-1999
		JP 5509437 T	22-12-1993
		WO 9214259 A1	20-08-1992

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
4/W32367WO		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/03964	16/10/2000	19/10/1999
International Patent Classification (IPC) or national classification and IPC H01J49/00		
Applicant SHIMADZU RESEARCH LABORATORY (EUROPE) LTD. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
02/05/2001	13.02.2002
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer van Toledo, W Telephone No. +49 89 2399 2481

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/03964

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-17 as originally filed

Claims, No.:

1-32 as originally filed

Drawings, sheets:

1/6-6/6 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

   ☐ the entire international application.

   ☒ claims Nos. 28-31.

because:

   ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

   ☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

   ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

   ☒ no international search report has been established for the said claims Nos. 28-31.

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

   ☐ the written form has not been furnished or does not comply with the standard.

   ☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

   Novelty (N) Yes: Claims 1-27, 32

	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-27, 32
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-27, 32
	No:	Claims	

2. Citations and explanations
see separate sheet

Reference is made to the following documents:

D1: GB-A-1346393

D2: SCHLUNEGGER U P ET AL: 'FREQUENCY SCAN FOR THE ANALYSIS OF HIGH MASS IONS GENERATED BY MATRIX-ASSISTED LASER DESORPTION/IONIZATION IN A PAUL TRAP' RAPID COMMUNICATIONS IN MASS SPECTROMETRY, LONDON, GB, vol. 13, 1999, pages 1792-1796, XP000972551 cited in the application

D3: US-A-5 206 506 (KIRCHNER NICHOLAS J) 27 April 1993 (1993-04-27)

D4: SHERETOV E P ET AL: 'Opportunities for optimization of the rf signal applied to electrodes of quadrupole mass spectrometers. part ii. EC signals' INTERNATIONAL JOURNAL OF MASS SPECTROMETRY, ELSEVIER SCIENCE PUBLISHERS, AMSTERDAM, NL, vol. 198, no. 1-2, April 2000 (2000-04), pages 97-111, XP004193741 ISSN: 1387-3806

Document D1 was not cited in the international search report. A copy of the document is appended hereto.

Re Item V

R asoned statement under Article 35(2) with regard to novelty, inventive st p or industrial applicability; citations and explanations supporting such statem nt

The present application relates methods and an apparatus for driving a quadrupole ion trap device.

1. Novelty

Document D1 is regarded as being the closest prior art to the subject-matter of claims 1 and 16, and discloses a method and an apparatus for driving a quadrupole ion mass analyser device, comprising

- means for creating a digital signal (Fig.4: 'clock generator');
- a switch arranged to be controlled by said digital signal causing the switch to switch between two voltage levels to generate a rectangular wave voltage (Figs. 4, p.4, lines 118-121) which is supplied to said quadrupole ion trap device for analysing ion masses;
- supplying the time-varying rectangular wave voltage to the quadrupole ion trap device to trap ions in a predetermined range of mass-to-charge ratio; and
- varying the predetermined range of mass-to-charge ratio of ions that can be trapped (p.2, lines 17-22).

The present subject-matter (see independent claims 1 and 16) differs from the quadrupole ion mass analyser of D1 in that a digital control of the mass-to-charge ratio range variation is disclosed and in that further a time-varying dipole excitation voltage has been supplied to cause mass-selective resonant oscillatory motion of the ions in the device.
D2 discloses a quadrupole MALDI ion trap with digital waveform control and frequency scanning but does not disclose the use of digitally controlled switches to produce rectangular wave forms.

Consequently, the subject-matter of claims 1 and 16, and therefore of the respective dependent claims, is new (Article 33.2 PCT).

2. Inventive step

The technical problem may be regarded as how to provide a wider range of mass scanning and a wider range of control parameters in a method and apparatus for driving a quadrupole ion trap (description p.16, lines 7-19). This technical problem has been solved according to present claims 1 and 16. Document D3 teaches away from the use of quadrupole mass analysers (Cols.6-8). Instead, it discloses an alternative ion processing unit comprising a series of perforated electrode sheets. Rectangular wave forms to steer the unit are not disclosed. The cited documents do not contain any suggestions, which, alone or in combination, would lead to the present subject-matter.

Therefore, claims 1 and 16, as well as the claims dependent thereon, involve an inventive step (Article 33.3 PCT).

3. Industrial applicability

of the claimed subject-matter is obvious (Article 33.4 PCT).

* * * * * * * * *

If the present application enters the regional phase before the EPO, document D4 will be regarded as an Art. 54(2) EPC document in case the priority date of the present application is not valid.